

Fishery Data Series No. 03-24

**Harvest Estimates for the Macaulay (Gastineau)
Hatchery Roadside Sport Fishery in Juneau, Alaska
during 2002**

by

Bruce A. White

November 2003

Alaska Department of Fish and Game

Division of Sport Fish



Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition.

Weights and measures (metric)		General		Mathematics, statistics, fisheries	
centimeter	cm	all commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.	alternate hypothesis	H _A
deciliter	dL	all commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	e
gram	g	and	&	catch per unit effort	CPUE
hectare	ha	at	@	coefficient of variation	CV
kilogram	kg	compass directions:		common test statistics	F, t, χ^2 , etc.
kilometer	km	east	E	confidence interval	C.I.
liter	L	north	N	correlation coefficient	R (multiple)
meter	m	south	S	correlation coefficient	r (simple)
metric ton	mt	west	W	covariance	cov
milliliter	ml	copyright	©	degree (angular or temperature)	°
millimeter	mm	corporate suffixes:		degrees of freedom	df
Weights and measures (English)		Company	Co.	divided by	÷ or / (in equations)
cubic feet per second	ft ³ /s	Corporation	Corp.	equals	=
foot	ft	Incorporated	Inc.	expected value	E
gallon	gal	Limited	Ltd.	fork length	FL
inch	in	et alii (and other people)	et al.	greater than	>
mile	mi	et cetera (and so forth)	etc.	greater than or equal to	≥
ounce	oz	exempli gratia (for example)	e.g.,	harvest per unit effort	HPUE
pound	lb	id est (that is)	i.e.,	less than	<
quart	qt	latitude or longitude	lat. or long.	less than or equal to	≤
yard	yd	monetary symbols (U.S.)	\$, ¢	logarithm (natural)	ln
Time and temperature		months (tables and figures): first three letters	Jan,...,Dec	logarithm (base 10)	log
day	d	number (before a number)	# (e.g., #10)	logarithm (specify base)	log ₂ etc.
degrees Celsius	°C	pounds (after a number)	# (e.g., 10#)	mid-eye-to-fork	MEF
degrees Fahrenheit	°F	registered trademark	®	minute (angular)	'
hour	h	trademark	™	multiplied by	x
minute	min	United States (adjective)	U.S.	not significant	NS
second	s	United States of America (noun)	USA	null hypothesis	H ₀
Physics and chemistry		U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)	percent	%
all atomic symbols				probability	P
alternating current	AC			probability of a type I error (rejection of the null hypothesis when true)	α
ampere	A			probability of a type II error (acceptance of the null hypothesis when false)	β
calorie	cal			second (angular)	"
direct current	DC			standard deviation	SD
hertz	Hz			standard error	SE
horsepower	hp			standard length	SL
hydrogen ion activity	pH			total length	TL
parts per million	ppm			variance	var
parts per thousand	ppt, ‰				
volts	v				
watts	w				

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HATCHERY ROADSIDE SPORT FISHERY IN JUNEAU, ALASKA
DURING 2002**

by

Bruce A. White

Alaska Department of Fish and Game
Division of Sport Fish
Anchorage, Alaska

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Bruce A. White
Alaska Department of Fish and Game, Division of Sport Fish
P. O. Box 240020, Douglas, AK 99824-0020, USA

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ABSTRACT

Angler effort and sport harvests of chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, chum salmon *O. keta*, and pink salmon *O. gorbuscha* were estimated at Macaulay Hatchery from 10 June to 6 October 2002. An estimated 22,531 (SE = 746) angler-hours were expended to harvest a total of 1,121 (SE = 124) large chinook salmon at least 28 inches in total length, 93 (SE = 26) small chinook salmon (<28 inches in length), 11,521 (SE = 754) large coho salmon at least 16 inches in length, 571 (SE = 119) small coho salmon (<16 inches in length), 1,707 (SE = 303) chum salmon, and 1,078 (SE = 248) pink salmon. The chinook salmon harvest was a record high, 150% above the 1997–2001 average, and the coho harvest was the second highest at the hatchery, 56% above average. Angler effort was 0.5% above the 5-year average.

Key words: creel survey, roadside, Juneau, angler effort and harvest, sport fishery, hatchery, chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, chum salmon, *Oncorhynchus keta*, pink salmon, *Oncorhynchus gorbuscha*, Macaulay Hatchery, Gastineau Hatchery, Southeast Alaska

INTRODUCTION

Roadside sport fisheries in marine waters around Juneau, Alaska offer unique fishing opportunities for both Alaskan residents and tourists. Demand for these fishing opportunities is heavy, with 30,903 people residing in the Juneau Borough in 2002, according to the U.S. Census Bureau. Additionally, the number of visitors coming to Juneau has steadily increased from approximately 87,000 cruise ship passengers in 1982 to 720,000 in 2002. The number of independent travelers visiting Juneau in 2002 was estimated to be 130,000 (Juneau Convention and Visitors Bureau, Juneau, Alaska, personal communication).

The Macaulay Hatchery and its visitor center (prior to 2001 named Gastineau Hatchery), located about 3 miles north of downtown Juneau (Figure 1), is a popular destination for residents and tourists. The hatchery is owned and operated by Douglas Island Pink and Chum, Inc. (DIPAC), a private non-profit corporation. About 113,000 people toured the facility during the 2002 season (R. Focht, Director of Research and Evaluation, DIPAC, Juneau, personal communication).

To better accommodate increased use by anglers, Wayside Park was constructed during 2001 just north of the Macaulay Hatchery. The park included a van and wheelchair accessible dock for disabled anglers, along with restrooms, benches, and off-road parking. Construction of the \$2.5 million park (built with federal transportation funds) was completed in July,

2001. The original floating access dock next to the hatchery was permanently removed in the fall of 2000.

Salmon enhancement efforts at Macaulay and nearby Sheep Creek hatcheries (Figure 1) have been extensive including releases of chinook *Oncorhynchus tshawytscha*, coho *O. kisutch*, pink *O. gorbuscha*, and chum *O. keta* salmon (Farrington, *unpublished*). The two species of salmon most preferred by anglers in Southeast Alaska are chinook and coho salmon (Jones & Stokes 1991). The sport fishery at the Macaulay hatchery targets chinook, pink, and chum salmon from mid-June through August, and coho salmon from mid-August through late September or early October.

Since 1991, ADF&G staff has assisted the Macaulay Hatchery in developing an onsite creel program to estimate sport harvests at the site. The onsite creel survey at the hatchery provides detailed angler demographic and fishery performance information. Information gathered in this survey is more detailed than the information gathered through the Statewide Harvest Survey (SWHS), which also estimates sport harvests for the site “Shoreline-Gastineau Hatchery (DIPAC)” along with regionwide harvests, through the use of questionnaires mailed annually to a random sample of sport anglers (Jennings et al. *In prep*).

In 1994, ADF&G entered into an agreement with DIPAC to rear chinook salmon for release at the following sites in the Juneau area (Figure 1): Macaulay Hatchery, Fish Creek (north Douglas

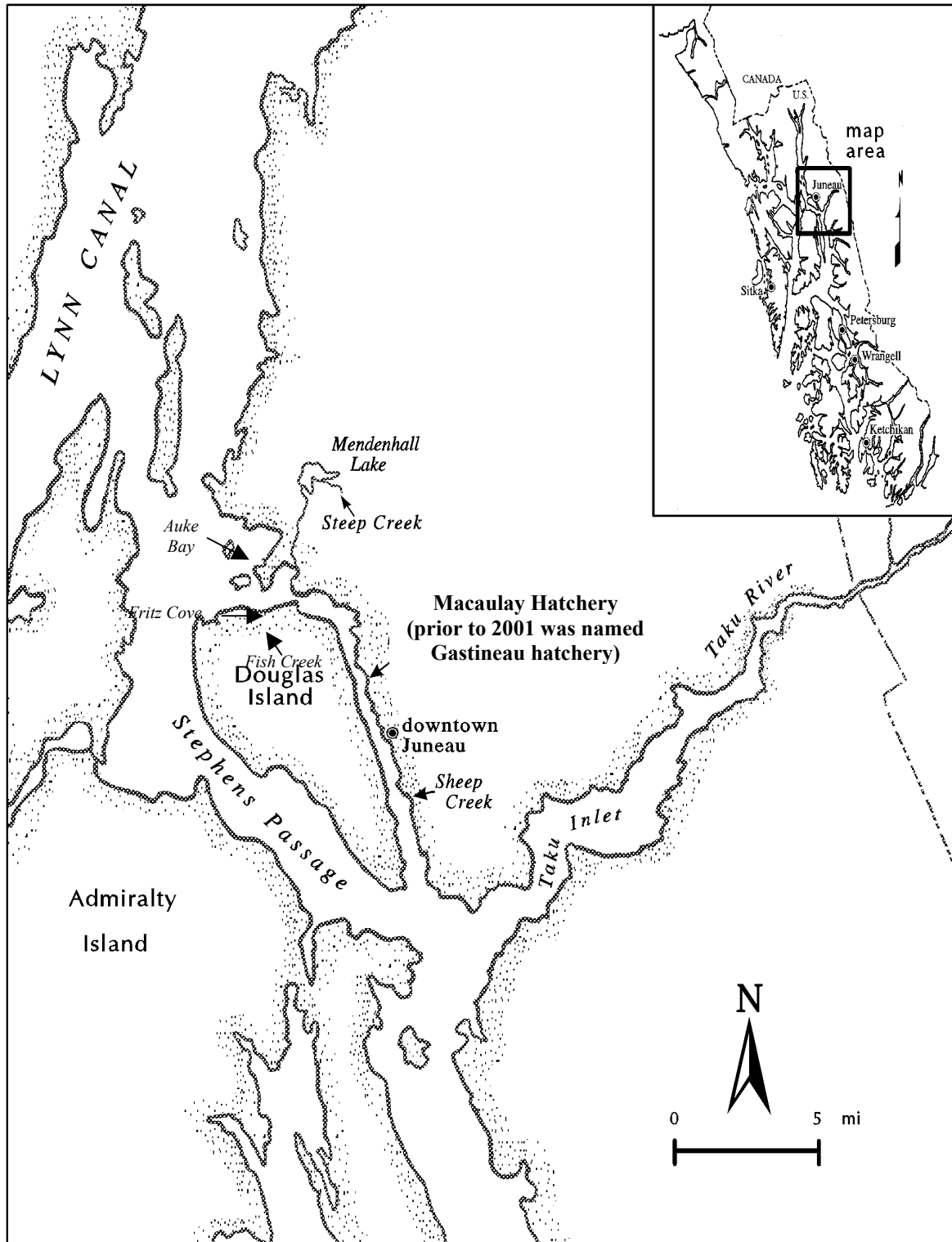


Figure 1.—Location of the Macaulay Hatchery, site of a roadside sport fishery in Juneau, northern Southeast Alaska.

Island), Auke Bay, and Sheep Creek (Bentz et al. 1996). This program was designed to increase sport fishing opportunities for chinook salmon in the Juneau marine boat fishery; marine shoreline fisheries at Macaulay Hatchery, Fritz Cove, Auke Bay; and freshwater and marine shoreline fisheries at Fish Creek. Although sport harvests of chinook salmon in Southeast Alaska are limited by an allocation and management plan, Alaska hatchery chinook salmon do not count toward the U.S./Canada Pacific Salmon Treaty catch totals. The onsite creel survey at Macaulay Hatchery provides additional information for evaluating the hatchery as a release site and terminal harvest area. In 2002, hatchery and ADF&G staff again cooperated to conduct the survey.

OBJECTIVE

The objective of the 2002 creel survey at the Macaulay Hatchery was to estimate the effort and harvest of chinook, coho, pink, and chum salmon from 10 June to 6 October, such that estimates were within the specified true values 95% of the time: $\pm 10\%$ for angler-hours of effort, $\pm 25\%$ for coho, $\pm 40\%$ for chinook, $\pm 30\%$ for pink, and $\pm 35\%$ for chum salmon harvests.

METHODS

The survey area within the newly constructed park was divided into two zones. The division was necessary due to the long, rectangular shape of the survey area, making it impossible to interview anglers exiting opposite ends of the survey area concurrently. The zone nearest the hatchery (zone A) included the public fishing dock and 300 ft of shoreline, 150 ft in either direction from the dock's access ramp. Zone A is identical to the area that in previous years was the designated non-snagging zone. The second zone (zone B) included the remaining 300 ft of beach extending north from the boundary of (zone A) to the end of the park. Zone B had previously been defined as the snagging zone. Both zones were clearly marked, discrete in shape and size, and easily surveyed.

The bag and possession limit for chinook salmon at the hatchery was 4 fish from 8 June to 31 August 2002, with no size limit—and chinook

salmon harvested by nonresidents in the terminal area during this period did not count toward their 3-fish annual limit. Chinook salmon were classified as large (≥ 28 inches TL), or small (< 28 inches TL). After 31 August, the chinook salmon bag limit was 2 fish ≥ 28 inches TL for residents and 1 fish ≥ 28 inches TL for nonresidents. The bag limit for pink, chum, and coho salmon ≥ 16 inches TL was 6 per day for each species, and an additional 10 salmon < 16 inches TL could be taken in combination. Coho salmon were classified as either 'large' (≥ 16 inches TL) or 'small' (< 16 inches TL).

A stratified, two-stage roving creel survey based on expansion of sample ratios was used to estimate fishing effort and harvest. The survey period was from 10 June to 6 October 2002. Days were primary sampling units, and anglers within days were secondary sampling units. Two zones, 17 weekly (7-day) strata, and weekday versus weekend-holiday stratification were maintained¹. Therefore, there were 68 discrete temporal/ spatial strata.

For the 2002 creel survey design, the number of weekend/holiday days sampled remained the same as in previous years (2 days); i.e., every Saturday and Sunday was sampled. During weeks with holidays, (making for 3 possible survey days), two sampling days were randomly selected. Two weekdays (Monday through Friday) were also randomly selected for sampling. The sampling day was defined as beginning at early civil twilight or 0600 h (whichever was later), and ended at late civil twilight, as computed for the midday of the sample week. Most angling at the hatchery was expected to occur between those hours. During each sampling day, anglers were counted six times within each zone (zone A and zone B). The first count was randomly selected from the mid-point of the first, second, or last third of the first one-sixth of each sampling day. Subsequent counts occurred at intervals equal to one-sixth the length of each sampling day.

¹ Weekdays = Mondays–Fridays. Weekend/holidays = Saturdays, Sundays, Independence Day (observed on 4 July), and Labor Day (2 September).

Effort was estimated by multiplying the average angler count for the day for each site by the hours available for sampling each day. The harvest per unit effort (HPUE) for each fish species was estimated from completed-trip interviews. The estimated harvest was obtained from the product of the effort and HPUE estimates.

When not counting anglers, survey personnel interviewed anglers completing their trip without regard to angler success (angler harvest). Interviews were conducted during 1-hour periods that alternated between sites (non-snagging or snagging). The site to start interviews in each stratum was selected at random, and alternated each day sampled.

During each interview, anglers were asked to report their effort and harvest at the site being sampled. In addition, technicians recorded the age class (child—under 16 years of age, adult—16 to 60 years, or senior—over the age of 60) and the residency (Alaska resident or non-resident) of the angler. As many completed-trip interviews as possible were obtained during each day selected for sampling.

Because hatchery technicians had other assigned duties, interviews were not conducted at various times during the day; however, sampling of anglers exiting the survey area was thought to occur roughly in proportion to the number exiting the site over time.

Angler effort and harvest by species along with associated variances and standard errors were calculated by the following procedures.

The harvest in each stratum (and within each specific class) was estimated by

$$\hat{H}_h = D_h \bar{H}_h \quad (1)$$

$$\bar{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \quad (2)$$

where \hat{H}_{hi} is the estimated harvest in day i stratum h , d_h is the number of days sampled in stratum h , and D_h is the total number of days in stratum h .

The variance of the harvest in each stratum (and within each specific class) was estimated by

$$v[\hat{H}_h] = (1 - f_{hi}) D_h^2 \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \bar{H}_h)^2}{d_h (d_h - 1)} + f_{ih}^{-1} \sum_{i=1}^{d_h} \hat{v}[\hat{H}_{hi}] \quad (3)$$

where $f_{ih} = d_h / D_h$.

Harvest for each sampling day was estimated by

$$\hat{H}_{hi} = \hat{E}_{hi} \overline{HPUE}_{hi}^* \quad (4)$$

where \overline{HPUE}_{hi}^* is the jackknife estimate of mean HPUE during stratum h day i , and \hat{E}_{hi} is the fishing effort in angler-hours during the same time.

Angler effort in each day was estimated by

$$\hat{E}_{hi} = T_h \bar{x}_{hi} \quad (5)$$

where T_h is the number of hours in a sampling day and \bar{x}_{hi} is the average number of anglers counted in day i stratum h . If $\bar{x}_{hi} = 0$ and anglers were interviewed, then \hat{H}_{hi} in equation (4) was set equal to the observed harvest. In contrast, if $\bar{x}_{hi} > 0$ and no anglers were interviewed, then \overline{HPUE}_{hi}^* in equation (4) was set equal to the mean \overline{HPUE}_{hi}^* for the stratum.

The variance of E_{hi} was estimated by (Wolter 1985)

$$v[\hat{E}_{hi}] = T_h^2 \frac{\sum_{j=2}^{r_{hi}} (x_{hij} - x_{hi(j-1)})^2}{2r_{hi}(r_{hi} - 1)} \quad (6)$$

where r_{hi} is the number of times anglers were counted in day i .

The variance of the harvest H_{hij} in a day was estimated by (Goodman 1960).

$$v[\hat{H}_{hi}] = v[\hat{E}_{hi}]\overline{HPUE}_{hi}^{*2} + v[\overline{HPUE}_{hi}^*]\hat{E}_{hi}^2 - v[\hat{E}_{hi}]v[\overline{HPUE}_{hi}^*] \quad (7)$$

The \overline{HPUE}_{hi}^* and its variance were calculated according to procedures in Efron (1982). The inherent correctable bias of m_{hi}^2 (the number of interviews in a sampling period) of jackknife estimates was removed according to the procedure in Efron (1982, p. 6).

Harvest and effort (and their variances) for the entire season were the sums of the estimates for each stratum. The standard error (SE) for the estimate (\hat{N}) is the square root of the variance. Relative precision (RP) of the estimates with a 95% confidence interval was calculated using equation (8).

$$RP(\hat{N}) = \left[\frac{(SE * 1.96)}{\hat{N}} \right] * 100 \quad (8)$$

RESULTS

During the 2002 fishing season at Macaulay Hatchery, 3,414 angler interviews and 768 angler counts were conducted. Total estimated fishing effort was 22,531 (SE = 746) angler-hours. The amount of angler effort was fairly consistent throughout the season; only the week of 5 August–11 August showed a reduction in effort (Table 1). An estimated 1,120 (SE = 124) large chinook salmon, 11,521 (SE = 754) large coho salmon, 1,706 (SE = 303) chum salmon, and 1,079 (SE = 248) pink salmon were harvested at Macaulay Hatchery from 10 June to 6 October 2002. In addition, 92 (SE = 26) small chinook salmon and 570 (SE = 119) small coho salmon were also harvested.

Large chinook salmon were harvested from mid-June through the first week of August. The peak harvest occurred during the week of 22 July–28 July, when 179 large chinook salmon were harvested. The majority of small Chinook salmon were harvested from mid-June to mid-July.

The majority of the pink and chum salmon were harvested during July and August. A few coho salmon were taken in early August, but most

were harvested from mid-August through the end of the survey in early October.

Alaska residents accounted for 80% of the total effort and 88% of the large chinook, 90% of the large coho, 76% of the chum, and 79% of the pink salmon harvest (Table 2).

Adults accounted for 65% of the effort, and 68% of the large chinook, 78% of the large coho, 71% of the chum, and 58% of the pink salmon harvested. Children accounted for 27% of the effort, and 22% of the large chinook, 12% of the large coho, 23% of the chum, and 18% of the pink salmon harvested. Seniors accounted for 8% of the effort, and 11% of the large chinook, 11% of the large coho, 6% of the chum and 25% of the pink salmon harvested (Table 3).

The relative precision for the estimates of effort, large chinook, and large coho salmon were well within goals stated in the objective. The relative precision goal for the chum salmon harvest was met, while the goals for pink, small chinook and small coho salmon harvests were exceeded (Table 1). Detailed sampling information, including angler counts and numbers of completed interviews for overall estimates, are presented in Appendix A1. Appendix A2 lists archived files containing final data sets used for the analysis.

DISCUSSION

The 2002 sport fishing season at Macaulay Hatchery established a new harvest record for large chinook salmon (1,121 fish) and nearly set a harvest record for large coho salmon. The number of chum salmon harvested was above average, while the pink salmon harvest was well below average. Angler effort at the site was about equal to the 5-year average (Table 4). The overall chinook salmon return to the hatchery was also the highest on record, and the 1,121 large chinook salmon harvested was 150% above the 5-year average. The chinook salmon harvest was relatively consistent from 17 June to 4 August, with the greatest one week harvest during the week of 22 July–28 July. While the overall coho salmon return to Macaulay Hatchery was about average in 2002 (R. Focht, DIPAC Director of Research and Evaluation, Juneau, personal communication) the harvest of 11,521 large coho salmon was second only to the

Table 1.—Summary of estimated weekly angler effort and harvest of large (≥ 16 in) and small (< 16 in) coho salmon, large (≥ 28 in) and small (< 28 in) chinook salmon, chum salmon, and pink salmon at the Macaulay Hatchery roadside fishery in 2002.

Weekly period	Effort		Large (≥ 16 in) coho salmon		Small (< 16 in) coho salmon		Large (≥ 28 in) chinook salmon		Small (< 28 in) chinook salmon		Chum salmon		Pink salmon	
	Angler-hours	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a
6/10-6/16	1,090	118	—	—	—	—	48	21	20	18	9	12	—	—
6/17-6/23	1,040	86	—	—	—	—	101	24	2	1	29	18	—	—
6/24-6/30	1,339	344	—	—	—	—	135	28	6	3	91	38	—	—
7/01-7/07	1,723	212	—	—	—	—	161	41	19	11	261	105	—	—
7/08-7/14	1,500	194	—	—	—	—	126	29	14	9	195	49	7	4
7/15-7/21	1,413	168	2	1	—	—	142	64	—	—	238	44	31	16
7/22-7/28	1,433	223	—	—	—	—	179	59	1	1	331	74	48	26
7/29-8/04	1,515	137	2	2	13	7	115	26	4	3	384	254	218	47
8/05-8/11	863	280	26	11	5	4	71	49	1	1	63	36	231	71
8/12-8/18	1,989	115	367	96	120	34	38	18	21	10	14	10	466	225
8/19-8/25	1,805	274	1,121	208	139	42	4	4	4	4	87	58	66	52
8/26-9/01	1,469	95	1,573	115	172	84	—	—	—	—	—	—	12	11
9/02-9/08	1,557	145	3,502	343	32	12	—	—	—	—	4	4	—	—
9/09-9/15	1,728	148	2,631	566	89	63	—	—	—	—	—	—	—	—
9/16-9/22	1,180	111	1,556	221	—	—	—	—	—	—	—	—	—	—
9/23-9/29	698	70	609	121	—	—	—	—	—	—	—	—	—	—
9/30-10/06	189	50	132	45	—	—	—	—	—	—	—	—	—	—
Total	22,531	746	11,521	754	571	119	1,121	124	93	26	1,707	303	1,078	248
Relative precision	6%		13%		41%		22%		55%		35%		45%	
Goal relative precision	10%		25%		25%		40%		40%		35%		30%	

^a Standard error of effort or harvest estimate.

^b Columns may not sum exactly to the totals because of rounding errors.

Table 2.—Effort and harvest estimates by angler residency of large (≥ 16 in) and small (< 16 in) coho salmon, large (≥ 28 in) and small (< 28 in) chinook salmon, chum salmon, and pink salmon at the Macaulay Hatchery roadside fishery in 2002.

Angler residency	Angler effort		Large (≥ 16 in) coho salmon		Small (< 16 in) coho salmon		Large (≥ 28 in) chinook salmon		Small (< 28 in) chinook salmon		Chum salmon		Pink salmon	
	Hours	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a
Resident	17,918	683	10,413	695	482	121	986	123	85	26	1,295	293	856	207
Nonresident	4,610	295	1,107	166	90	36	135	31	8	4	412	104	223	73
Total ^b	22,528	744	11,520	715	572	126	1,121	127	93	26	1,707	311	1,079	219

^a Standard error of the effort and harvest estimates.

^b Totals for hours and harvests may differ slightly from overall estimates because of rounding error. Totals for standard errors will not equal the overall estimate standard errors because they are not independent estimates across angler types.

Table 3.—Effort and harvest estimates by angler age class of large (≥ 16 in) and small (< 16 in) coho salmon, large (≥ 28 in) and small (< 28 in) chinook salmon, chum salmon, and pink salmon at the Macaulay Hatchery roadside fishery in 2002.

Angler age class	Angler effort		Large (≥ 16 in) coho salmon		Small (< 16 in) coho salmon		Large (≥ 28 in) chinook salmon		Small (< 28 in) chinook salmon		Chum salmon		Pink salmon	
	Hours	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a
Adult	14,589	535	8,956	654	350	81	757	99	72	23	1,220	232	624	126
Child	6,082	380	1,359	169	123	54	244	73	10	6	385	139	189	46
Senior	1,857	160	1,205	154	97	39	121	46	11	7	104	50	265	140
Total ^b	22,528	676	11,520	693	570	105	1,122	131	93	25	1,709	276	1,078	194

^a Standard error of the effort and harvest estimates.

^b Totals for hours and harvests may differ slightly from overall estimates because of rounding error. Totals for standard errors will not equal the overall estimate standard errors because they are not independent estimates across angler types.

Table 4.—Summary of estimated angler effort and harvest of large (≥ 16 in) coho salmon, large (≥ 28 in) chinook salmon, chum salmon, and pink salmon from onsite creel surveys at the Macaulay Hatchery roadside fishery in 1990 and 1993–2002.

Year (survey period)	Angler-hours	SE ^a	Large (≥ 16 in) coho salmon		Large (≥ 28 in) chinook salmon		Chum salmon		Pink salmon	
			Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a
1990 (5 May–11 Nov) ^b	5,207	477	69	35	0	—	118	45	4,225	961
1993 (5 Jul–17 Oct) ^c	15,825	584	7,057 ^d	520	118 ^d	34	1,515	310	713	95
1994 (4 Jul–9 Oct) ^e	24,192	905	3,509	317	70	17	593	66	9,197	560
1995 (3 Jul–25 Sep) ^f	21,546	555	2,212	303	157	36	2,047	254	3,421	250
1996 (21 Jun–23 Sep) ^g	19,189	555	2,860	285	695	73	2,274	250	1,039	135
1997 (16 Jun–5 Oct) ^h	22,385	654	3,507	436	931	123	1,605	235	2,878	297
1998 (8 Jun–27 Sep) ⁱ	28,273	701	11,722	937	471	63	2,376	280	5,653	414
1999 (7 Jun–3 Oct) ^j	18,828	541	7,275	382	109	23	1,028	173	2,986	303
2000 (12 Jun–6 Oct) ^k	23,536	567	10,303	461	155	29	1,518	190	2,387	235
2001 (13 Jun–7 Oct) ^l	19,045	591	4,222	290	581	82	1,176	178	1,453	201
5-year (1997–2001) mean	22,413		7,406		449		1,541		3,071	
2002 (11 Jun–6 Oct)	22,531	746	11,521	754	1,121	124	1,707	303	1,078	248

^a Standard error (SE) of effort or harvest.

^b Estimates from Suchanek and Bingham (1991).

^c Estimates from Beers and Marshall (1994).

^d Includes both large and small fish.

^e Estimates from Beers (1995).

^f Estimates from Beers (1996).

^g Estimates from Beers (1997).

^h Estimates from Frenette (1998).

ⁱ Estimates from Frenette (1999).

^j Estimates from Jaenicke (2000).

^k Estimates from Jaenicke (2001).

^l Estimates from White (2003).

1998 harvest of 11,772 coho salmon. The total coho salmon harvest was 56% above the 5-year average. While chum salmon returns to the hatchery were below average, angler harvest was 11% above the 5-year average. Even though pink salmon returns to the hatchery were near average, harvest was 65% below the 5-year average.

During 2002, with the construction of Wayside Park complete, angler effort returned to levels seen during the years prior to the park's construction. Angler effort was up 18% from 2001 (White 2003). The decrease in the amount of angler effort observed last year may have been due in part to construction activity associated with Wayside Park. In 2002, Juneau experienced slightly colder and wetter weather in comparison to the previous five years, but this did not have an effect on the amount of angler effort. Residency information collected from surveys conducted from 1999 to 2002 indicates that over this period,

the vast majority (80%) of the anglers using this site were residents.

Chinook salmon smolts reared at Macaulay Hatchery are released at three locations, onsite in Gastineau Channel, at Fish Creek on the north end of Douglas Island, and in Auke Bay (Bentz et al. 1996). The latter two sites provide additional chinook salmon fishing opportunities for marine boat, shoreline, and freshwater anglers.

Harvest estimates and coded wire tag recovery information generated during the Juneau marine boat creel survey from 29 April to 29 September, indicated that these anglers also benefited from DIPAC enhancement activities. In 2002, Juneau marine boat anglers harvested an estimated 3,295 chinook salmon that originated from DIPAC hatchery releases (Hubartt et al. *In prep*). This was approximately 51% of total chinook salmon harvested in the 2002 Juneau area marine boat sport fishery. An estimated 448 (SE = 132) of the

chinook salmon taken in the Juneau area marine boat sport fishery originated from releases directly at Macaulay Hatchery (Gastineau Channel). DIPAC also contributed an estimated 3,991 coho salmon to the marine boat sport fishery. This is approximately 15% of the total estimated (26,273, SE = 3,239) coho salmon harvested in the Juneau area by marine boat sport anglers.

Commercial fishers harvested about 1,400 chinook salmon from the Juneau releases. Chinook salmon from the Auke Bay release site accounted for 40% of the DIPAC chinook salmon harvested in the commercial fishery. The Fish Creek and Macaulay hatchery release sites contributed 28% and 30%, respectively. Finally, a total of 4,400 adult chinook salmon returned to the hatchery rack (R. Focht, DIPAC, Juneau, personal communication).

Beginning with the 1997 brood year, the Andrew Creek stock was again released from all three release sites in Juneau. Returns of the Andrew Creek stock have been better than the returns of the King Salmon river stock, which was being developed as a possible new brood stock for the hatchery (R. Focht, DIPAC, Juneau, personal communication). Other factors that affected this year's return were the relatively better ocean survival of the 1996 and 1997 brood year and a significant component of the Auke Creek released fish returning to the hatchery's terminal area. Terminal area regulations in Gastineau Channel surrounding the hatchery and in nearby Auke Bay and Fritz Cove provided increased chinook salmon bag limits (4 fish, no size limit) to harvest hatchery returns during the period from 8 June to 31 August.

This opportunity was important, as the bag limit outside the terminal area was either 1 or 2 chinook salmon ≥ 28 inches TL. The liberal regulations, coupled with substantial hatchery returns, provided increased opportunities for a large number of anglers. Even with the increased bag limit, the exploitation rate of chinook salmon returning to the hatchery terminal area was only 28%.

Harvest estimates for the onsite survey at Gastineau Hatchery have been compared to the "parallel" estimates from the SWHS (i.e., for "Shoreline-Gastineau Hatchery-DIPAC" in 2001,

Jennings et al. *In prep*) from 1994 though 2001. Ninety-five percent (95%) confidence intervals for several of the paired estimates do not overlap, suggesting the two procedures yield dissimilar estimates.

A two-tailed test of the hypotheses (H_0) that both survey procedures yield similar estimates was tested during 2001 (White 2003) using the Wilcoxon Signed Ranks test (Conover 1980)

The Wilcoxon test results suggested the two survey methods yield different ($\alpha \leq 0.1$) results for coho, pink, chum, and all salmon. It is not known why estimates for these species at Gastineau Hatchery are higher in our creel survey.

We have no reason to suspect the observed differences are due to biases in the onsite survey estimates, but the possibility of some bias in these estimates cannot be absolutely ruled out.

For a more detailed discussion on why the two surveys sometimes yield different results, see (White 2003).

CONCLUSIONS AND RECOMMENDATIONS

Macaulay Hatchery plays an important role in providing fishing opportunities to residents and non-residents alike, who may be limited by time or other constraints to participate in remote roadside or marine boat fisheries. The Macaulay Hatchery roadside fishery is unique because it represents a centrally located, easily accessible area that provides concentrated angler effort and harvest near an area where salmon congregate, a hatchery fish ladder. Increased fishing opportunities are also provided by hatchery returns for marine boat anglers on both charter and non-charter vessels. Pressure on the wild stocks of salmon in the Juneau area is likely reduced due to the opportunities provided by the hatchery.

Documentation of class specific harvests at the hatchery's terminal harvest area through onsite creel surveys can be used to supplement harvest and effort information for the Juneau area provided by the SWHS and marine boat surveys. This survey can also be helpful in ground truthing SWHS estimates of harvest at the Macaulay Hatchery shoreline fishery.

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APPENDIX A

Appendix A1.—Summary of sampling results by date at Macaulay Hatchery in 2002.

Week	Stratum ^a	Date	Site	ANGLER COUNTS			INTERVIEW SAMPLING INFORMATION							
				No.	Mean	SD	No.	Effort	Large chinook harvest	Small chinook harvest	Large coho harvest	Small coho harvest	Pink harvest	Chum harvest
6/10-6/16	WD	11-Jun	NON	6	5	4.05	20	31.25	2	0	0	0	0	0
6/10-6/16	WD	11-Jun	SNAG	6	3	3.69	9	9.25	1	1	0	0	0	1
6/10-6/16	WD	13-Jun	NON	6	5.83	4.07	28	61.75	0	0	0	0	0	0
6/10-6/16	WD	13-Jun	SNAG	6	4.83	5.34	16	58	1	0	0	0	0	0
6/10-6/16	WE/H	15-Jun	NON	6	5.17	3.13	38	63	6	0	0	0	0	0
6/10-6/16	WE/H	15-Jun	SNAG	6	0.67	0.52	8	6	0	0	0	0	0	0
6/10-6/16	WE/H	16-Jun	NON	6	7.83	3.82	27	62.75	1	0	0	0	0	0
6/10-6/16	WE/H	16-Jun	SNAG	6	2.33	2.58	4	6	0	0	0	0	0	0
6/17-6/23	WD	19-Jun	NON	5	4.4	1.95	29	40	2	0	0	0	0	0
6/17-6/23	WD	19-Jun	SNAG	5	2.8	2.77	10	9.25	1	0	0	0	0	0
6/17-6/23	WD	20-Jun	NON	6	4.33	3.61	24	39.5	5	0	0	0	0	4
6/17-6/23	WD	20-Jun	SNAG	6	3.17	3.13	9	16.25	1	0	0	0	0	0
6/17-6/23	WE/H	22-Jun	NON	6	8.17	6.18	46	94.5	8	1	0	0	0	2
6/17-6/23	WE/H	22-Jun	SNAG	6	4	3.52	21	38.75	8	0	0	0	0	0
6/17-6/23	WE/H	23-Jun	NON	6	8.17	4.49	21	46.5	4	0	0	0	0	2
6/17-6/23	WE/H	23-Jun	SNAG	6	2.67	3.88	9	14.5	1	0	0	0	0	0
6/24-6/30	WD	26-Jun	NON	6	4.5	4.04	46	79	11	0	0	0	0	1
6/24-6/30	WD	26-Jun	SNAG	6	3.17	4.36	25	40	7	0	0	0	0	2
6/24-6/30	WD	28-Jun	NON	5	13.6	10.71	38	81.25	5	0	0	0	0	4
6/24-6/30	WD	28-Jun	SNAG	5	3.8	3.19	14	22.75	4	0	0	0	0	5
6/24-6/30	WE/H	29-Jun	NON	5	3.2	2.86	17	24.5	1	0	0	0	0	1
6/24-6/30	WE/H	29-Jun	SNAG	5	3.6	3.51	15	17.75	3	0	0	0	0	3
6/24-6/30	WE/H	30-Jun	NON	6	6.5	4.09	31	57.25	3	3	0	0	0	2
6/24-6/30	WE/H	30-Jun	SNAG	6	1	0.63	14	14.75	0	0	0	0	0	0
7/01-7/07	WD	1-Jul	NON	6	3	3.79	21	34.75	1	0	0	0	0	0
7/01-7/07	WD	1-Jul	SNAG	6	1.83	1.47	11	25.5	3	4	0	0	0	2
7/01-7/07	WD	3-Jul	NON	6	6.33	3.01	25	42.25	3	0	0	0	0	4
7/01-7/07	WD	3-Jul	SNAG	6	2	2.9	10	18.25	3	0	0	0	0	0
7/01-7/07	WE/H	6-Jul	NON	6	10.5	3.33	56	151.75	20	5	0	0	0	3
7/01-7/07	WE/H	6-Jul	SNAG	6	10.33	9.69	25	46.75	9	0	0	0	0	12
7/01-7/07	WE/H	7-Jul	NON	5	18.4	6.23	49	132.15	10	0	0	0	0	36
7/01-7/07	WE/H	7-Jul	SNAG	5	9.6	11.24	12	30.75	0	0	0	0	0	4
7/08-7/14	WD	8-Jul	NON	6	12.67	8.96	57	109.5	8	0	0	0	0	12
7/08-7/14	WD	8-Jul	SNAG	6	4.17	2.32	9	31.75	4	0	0	0	0	8
7/08-7/14	WD	12-Jul	NON	6	8.17	4.22	53	118.25	8	3	0	0	0	7
7/08-7/14	WD	12-Jul	SNAG	6	2.5	1.87	9	11.25	3	0	0	0	0	5
7/08-7/14	WE/H	13-Jul	NON	6	7	7.92	58	111.75	5	1	0	0	4	4
7/08-7/14	WE/H	13-Jul	SNAG	6	1.33	2.16	12	8.25	0	0	0	0	0	0
7/08-7/14	WE/H	14-Jul	NON	6	9.5	6.95	46	69.25	2	2	0	0	1	5
7/08-7/14	WE/H	14-Jul	SNAG	6	1.67	2.73	11	12.5	1	0	0	0	0	5
7/15-7/21	WD	18-Jul	NON	6	10.33	6.28	35	61	7	0	0	0	2	2
7/15-7/21	WD	18-Jul	SNAG	6	5.17	3.54	30	47.75	2	0	0	0	2	13
7/15-7/21	WD	19-Jul	NON	6	6.33	4.97	49	93	0	0	0	0	0	13
7/15-7/21	WD	19-Jul	SNAG	6	4.5	4.14	13	20.75	7	0	0	0	0	5
7/15-7/21	WE/H	20-Jul	NON	6	7	5.55	54	112	9	0	0	0	1	23
7/15-7/21	WE/H	20-Jul	SNAG	6	6.5	3.62	31	34.75	2	0	0	0	2	18
7/15-7/21	WE/H	21-Jul	NON	5	3.2	3.56	31	62.25	5	0	2	0	0	9
7/15-7/21	WE/H	21-Jul	SNAG	5	1.6	2.61	4	1.25	0	0	0	0	0	0
7/22-7/28	WD	23-Jul	NON	6	10.5	7.66	20	45	9	0	0	0	2	5
7/22-7/28	WD	23-Jul	SNAG	6	7	6.07	17	28	3	0	0	0	0	8
7/22-7/28	WD	26-Jul	NON	6	6	5.69	25	35.75	4	0	0	0	0	9
7/22-7/28	WD	26-Jul	SNAG	6	3.17	5.08	6	9.5	1	0	0	0	1	7
7/22-7/28	WE/H	28-Jul	NON	6	6.33	4.93	28	43.25	1	0	0	0	5	5
7/22-7/28	WE/H	28-Jul	SNAG	6	2.83	3.66	24	35.25	0	1	0	0	1	10
7/29-8/04	WD	31-Jul	NON	6	9.67	5.82	50	155	15	1	0	3	19	0
7/29-8/04	WD	31-Jul	SNAG	6	2.33	1.86	10	10.5	2	0	0	0	2	1

-continued-

Appendix A1.–Page 2 of 3.

Week	Stratum ^a	Date	Site	ANGLER COUNTS			INTERVIEW SAMPLING INFORMATION							
				No.	Mean	SD	No.	Effort	Large chinook harvest	Small chinook harvest	Large coho harvest	Small coho harvest	Pink harvest	Chum harvest
7/29-8/04	WD	1-Aug	NON	6	9.17	6.4	32	79	6	0	0	0	15	7
7/29-8/04	WD	1-Aug	SNAG	6	5.17	2.56	15	15.75	0	0	0	0	4	24
7/29-8/04	WE/H	3-Aug	NON	6	9.67	5.79	45	96.75	14	0	0	1	6	1
7/29-8/04	WE/H	3-Aug	SNAG	6	4.33	2.58	21	38.5	0	0	0	0	2	7
7/29-8/04	WE/H	4-Aug	NON	6	10.33	7.5	49	133.5	8	1	2	3	7	3
7/29-8/04	WE/H	4-Aug	SNAG	6	3.33	1.63	23	36.25	0	0	0	0	5	2
8/05-8/11	WD	5-Aug	NON	6	8.67	6.09	30	70	12	0	1	0	15	4
8/05-8/11	WD	5-Aug	SNAG	6	4.33	3.61	21	26	0	0	0	0	9	5
8/05-8/11	WD	7-Aug	NON	6	1	1.55	10	20.5	0	0	1	0	11	2
8/05-8/11	WD	7-Aug	SNAG	6	0.17	0.41	10	8.5	0	0	1	1	2	0
8/05-8/11	WE/H	10-Aug	NON	6	11.17	10.44	33	72	3	0	6	0	17	0
8/05-8/11	WE/H	10-Aug	SNAG	6	2.33	3.01	10	40	2	0	5	0	3	1
8/05-8/11	WE/H	11-Aug	NON	6	3.17	4.49	23	32.75	0	1	0	3	6	0
8/05-8/11	WE/H	11-Aug	SNAG	6	2.17	3.13	19	23	2	0	0	0	14	6
8/12-8/18	WD	13-Aug	NON	6	12.5	6.22	38	51.25	1	0	2	4	29	1
8/12-8/18	WD	13-Aug	SNAG	6	5.33	3.33	15	26	2	0	3	1	3	0
8/12-8/18	WD	16-Aug	NON	6	12.17	5.19	19	77	2	1	18	2	1	0
8/12-8/18	WD	16-Aug	SNAG	6	6.67	4.59	30	46.75	0	0	15	2	17	0
8/12-8/18	WE/H	17-Aug	NON	6	14.5	9.33	50	109	0	0	38	3	10	0
8/12-8/18	WE/H	17-Aug	SNAG	6	9.17	3.06	32	56	0	6	13	0	20	1
8/12-8/18	WE/H	18-Aug	NON	6	8.67	5.79	42	122	1	0	10	25	2	0
8/12-8/18	WE/H	18-Aug	SNAG	6	4.33	3.61	27	56.25	1	0	7	14	7	2
8/19-8/25	WD	19-Aug	NON	6	11.5	9.27	37	56.75	0	0	8	7	8	0
8/19-8/25	WD	19-Aug	SNAG	6	9.17	5.31	25	47.25	0	0	20	5	0	8
8/19-8/25	WD	21-Aug	NON	6	5	4.73	25	42.5	1	0	62	5	0	0
8/19-8/25	WD	21-Aug	SNAG	6	3.83	4.26	22	32	0	1	54	3	0	0
8/19-8/25	WE/H	24-Aug	NON	6	16.17	6.79	47	107.25	0	0	56	0	0	12
8/19-8/25	WE/H	24-Aug	SNAG	6	7.33	7.69	27	45	0	0	22	1	2	0
8/19-8/25	WE/H	25-Aug	NON	6	14.17	5.34	40	96.25	0	0	71	0	0	1
8/19-8/25	WE/H	25-Aug	SNAG	6	7.33	1.86	27	71.5	0	0	33	7	0	0
8/26-9/01	WD	27-Aug	NON	6	10.67	1.86	52	113.25	0	0	130	22	3	0
8/26-9/01	WD	27-Aug	SNAG	6	3.5	2.26	17	27.5	0	0	15	16	0	0
8/26-9/01	WD	29-Aug	NON	6	9.17	3.19	39	69.5	0	0	93	1	0	0
8/26-9/01	WD	29-Aug	SNAG	6	2.5	1.05	24	38.25	0	0	20	2	0	0
8/26-9/01	WE/H	31-Aug	NON	6	15.5	8.87	46	95.75	0	0	118	0	0	0
8/26-9/01	WE/H	31-Aug	SNAG	6	6.17	6.52	28	55.75	0	0	65	4	1	0
8/26-9/01	WE/H	1-Sep	NON	5	10.8	5.4	64	128.5	0	0	94	1	0	0
8/26-9/01	WE/H	1-Sep	SNAG	5	2.2	2.17	20	36.25	0	0	50	1	0	0
9/02-9/08	WD	3-Sep	NON	5	13.4	9.45	52	98	0	0	113	3	0	1
9/02-9/08	WD	3-Sep	SNAG	5	4.4	2.7	17	25	0	0	36	1	0	0
9/02-9/08	WD	5-Sep	NON	6	8	2	30	48.5	0	0	64	1	0	0
9/02-9/08	WD	5-Sep	SNAG	6	4	3.52	17	25.5	0	0	42	1	0	0
9/02-9/08	WE/H	7-Sep	NON	6	12.17	5.34	30	39.5	0	0	160	1	0	0
9/02-9/08	WE/H	7-Sep	SNAG	6	3.33	3.93	4	4.5	0	0	22	0	0	0
9/02-9/08	WE/H	8-Sep	NON	6	12	2.76	46	57	0	0	174	0	0	0
9/02-9/08	WE/H	8-Sep	SNAG	6	4.33	4.41	12	22	0	0	41	0	0	0
9/09-9/15	WD	9-Sep	NON	6	12.33	5.43	67	93	0	0	273	0	0	0
9/09-9/15	WD	9-Sep	SNAG	6	7.33	7	23	50.25	0	0	35	14	0	0
9/09-9/15	WE/H	14-Sep	NON	3	6.67	5.51	38	78.25	0	0	61	0	0	0
9/09-9/15	WE/H	14-Sep	SNAG	3	3.33	4.93	17	38.75	0	0	17	0	0	0
9/09-9/15	WE/H	15-Sep	NON	6	11.17	6.97	59	89.25	0	0	94	9	0	0
9/09-9/15	WE/H	15-Sep	SNAG	6	3.5	3.27	27	41.75	0	0	56	1	0	0
9/16-9/22	WD	18-Sep	NON	5	7	3.67	24	44	0	0	106	0	0	0
9/16-9/22	WD	18-Sep	SNAG	5	2.4	2.19	3	4.5	0	0	5	0	0	0
9/16-9/22	WD	19-Sep	NON	6	9.17	5.31	28	45.75	0	0	52	0	0	0

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Week	Stratum ^a	Date	Site	ANGLER COUNTS			INTERVIEW SAMPLING INFORMATION							
				No.	Mean	SD	No.	Effort	Large chinook harvest	Small chinook harvest	Large coho harvest	Small coho harvest	Pink harvest	Chum harvest
9/16-9/22	WD	19-Sep	SNAG	6	2.5	3.08	17	30.25	0	0	32	0	0	0
9/16-9/22	WE/H	21-Sep	NON	6	11.67	5.16	51	111.25	0	0	134	0	0	0
9/16-9/22	WE/H	21-Sep	SNAG	6	3.83	4.79	18	29.5	0	0	31	0	0	0
9/16-9/22	WE/H	22-Sep	NON	3	11.67	6.11	20	32.75	0	0	18	0	0	0
9/16-9/22	WE/H	22-Sep	SNAG	3	5.67	2.31	8	15.25	0	0	20	0	0	0
9/23-9/29	WD	23-Sep	NON	5	7	4.9	21	36.5	0	0	35	0	0	0
9/23-9/29	WD	23-Sep	SNAG	5	1.2	1.1	10	26.5	0	0	17	0	0	0
9/23-9/29	WD	26-Sep	NON	5	5.4	2.3	29	32.5	0	0	33	0	0	0
9/23-9/29	WD	26-Sep	SNAG	5	1	1.22	1	0.5	0	0	2	0	0	0
9/23-9/29	WE/H	28-Sep	NON	5	5.4	4.72	22	24	0	0	7	0	0	0
9/23-9/29	WE/H	28-Sep	SNAG	5	3.2	2.95	7	5.5	0	0	2	0	0	0
9/23-9/29	WE/H	29-Sep	NON	5	4.4	2.3	7	8.25	0	0	1	0	0	0
9/23-9/29	WE/H	29-Sep	SNAG	5	3.4	1.52	1	1.5	0	0	0	0	0	0
9/30-10/06	WD	30-Sep	NON	6	2.17	2.64	24	23	0	0	2	0	0	0
9/30-10/06	WD	30-Sep	SNAG	6	0.33	0.52	6	5.5	0	0	2	0	0	0
9/30-10/06	WD	1-Oct	NON	4	0.5	1	1	2.5	0	0	6	0	0	0
9/30-10/06	WD	1-Oct	SNAG	4	0	0								
9/30-10/06	WE/H	5-Oct	NON	4	2	0.82	6	8.75	0	0	4	0	0	0
9/30-10/06	WE/H	5-Oct	SNAG	4	0.75	0.96	2	6	0	0	2	0	0	0
9/30-10/06	WE/H	6-Oct	NON	4	3.75	0.5	6	8	0	0	10	0	0	0
9/30-10/06	WE/H	6-Oct	SNAG	4	1	1.41								
Total				768			3414	6408	286	32	2865	168	262	364

^a WD = weekdays (Mondays–Fridays, except 4 July and 2 September); WE/H = weekend/holidays [Saturdays, Sundays, Independence Day (observed on 4 July) and Labor Day (2 September)]

Appendix A2.—Major computer files used for data analysis of 2002 Macaulay Hatchery roadside fishery. Custodian of data files listed below include the author and the Alaska Department of Fish and Game, Division of Research and Technical Services, Anchorage, Alaska. File archive name is “dipac_02.zip.”

File name	File type	File description
2002_DIPAC	XLS	Final edited ASCII data set worksheet [sheet1] in an EXCEL spreadsheet.
DIPAC02A	SAS	SAS program to reformat data file in 2002_DIPAC.XLS
DIPAC02	SAS7BDAT	Summary subset SAS data file: count and interview data
BOWEN02A	SAS	SAS program to estimate overall effort, harvests, and associated variances
DIPAC_02_Age_eff	SAS	SAS program to estimate effort, harvest, and associated variances by age class (A, C, S, U)
DIPAC_02_RESID_eff	SAS	SAS program to estimate effort, harvest, and associated variances by residency (R, N, and U)
DIPAC_02_SA	SAS	SAS program to summarize daily estimate of effort and harvest.
DIPAC_2002_analysis	XLS	Summary of 2002 data analysis and comparison with historical data in an EXCEL spreadsheet